

# Mitigating the Proliferation of Weapons of Mass Destruction



National Nuclear Security Administration's strategic goal to "detect, prevent, and reverse the proliferation of weapons of mass destruction, while promoting nuclear safety worldwide." Our staff travels to remote locations around the globe and reaches into space to provide enabling systems, science, technology, and expertise that will reduce these threats to the United States. The NP&A program works to provide performance and vulnerability assessments of both U.S. and foreign technical capabilities and facilities and associated assessment tools and technologies. The physical-protection systems that we are developing and evaluating include technologies deployable at home and abroad."

## Al Romig

Vice President  
Nonproliferation and  
Assessments

## Accelerating Our Drive to Make the World a Safer Place

*"The greatest threat before humanity today is the possibility of secret and sudden attack with chemical or biological or radiological or nuclear weapons... America, and the entire civilized world, will face this threat for decades to come."*

—President George W. Bush,  
at the National Defense University,  
February 2004



Sandia has supported the DOE's global nuclear material security efforts since 1974. Under a variety of programs, we have assisted in efforts to identify and

implement security improvements in the U.S. and in more than 50 countries around the world, many of them member states of the former Soviet Union. Recently we have provided assistance to strengthen the physical protection at facilities in 15 nations as a part of the DOE NNSA's Global Nuclear Security Program. These nations are Belarus, Bulgaria, the Czech Republic, Georgia, Hungary, Indonesia, Kazakhstan, Latvia, Lithuania, Poland, Portugal, Romania, Serbia, the Ukraine, and Uzbekistan.

Other work involves deployment of Sandia teams to Russia, Greece, Haiti, and Iraq in support of NNSA's Radiological Threat Reduction (RTR) Program working in cooperation with the NNSA, Department of State, a number of foreign governments. Sandia is also extending its security activities to border crossings for maritime transportation shipments bound for the U.S.

## Working with the Former Soviet Union

In the early 1990s, Sandia began helping to protect Russian weapons through the Cooperative Threat Reduction program. This involvement drew upon Sandia's knowledge of nuclear security, having held for many decades, the primary responsibilities for developing and implementing physical security for the entire U.S. weapons complex. We have expanded this mission to improve

the security of nuclear weapons, weapons-grade nuclear material, and transportation in Russia.

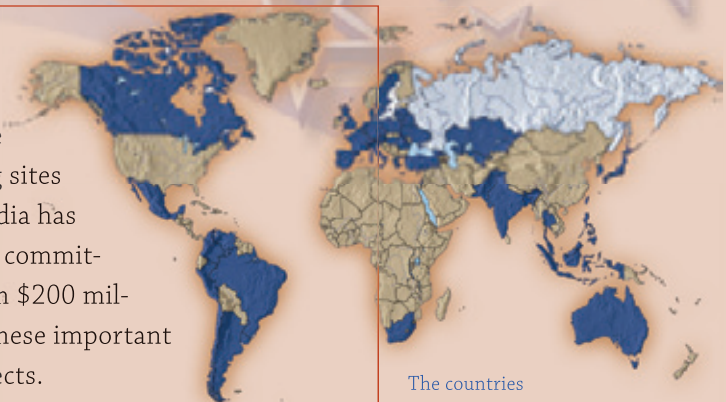
The NNSA's Materials Protection, Control and Accounting (MPC&A) Program reduces the threat to U.S. national security posed by unsecured Russian Federation fissile material and nuclear warheads. The MPC&A program has two primary emphases: 1) security of fissile materials and 2) security of nuclear weapons.

This year NNSA accelerated its schedule for work with the Russian Navy to secure warhead storage sites and rail transfer points. By the close of 2006, Sandia will have increased security at all of the tasked Russian Navy fuel and nuclear weapon storage sites. Sandia also concluded an agreement to secure two Strategic Rocket Forces sites by year-end, with the goal

of securing multiple facilities on the six remaining sites by 2008. Sandia has now spent or committed more than \$200 million toward these important security projects.

## Advanced stockpile monitoring technologies

A concrete example of the shared commitment to nonproliferation between the U.S. and Russia is the TOBOS program. Sandia has been working with the All Russian Institute of Automatics (VNIIA), under sponsorship of the Defense Threat Reduction Agency (DTRA) since 2001 to develop advanced monitoring technologies for the Russian Ministry of Defense. The TOBOS program (from the Russian acronym for

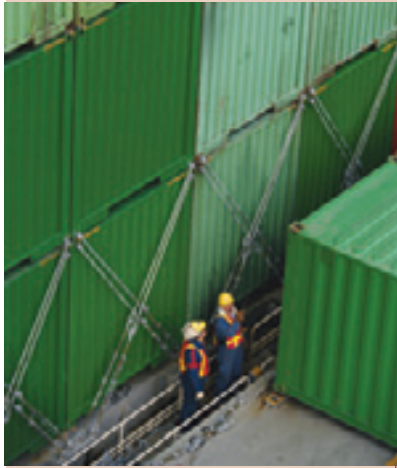


The countries indicated in blue on this map have received assistance from Sandia with cooperative programs designed to improve nuclear security.



U.S. and Russian officials marked a milestone in the TOBOS program, for securing Russian warheads, with the opening of a new test bed facility in St. Petersburg.





Safety and Security Technologies for Russian Warheads) tests technologies for enhanced warhead security and safety. Late in 2003, construction of a unique test bed at the ministry's TOBOS Research Center in St. Petersburg was completed and initial field trials were initiated. Sandia, in conjunction with VNIIA, is helping to develop the test program, with the Russian defense ministry approving all plans and operations. The Russian military and safety experts will evaluate monitoring technologies in normal operational and storage environments, extreme environmental conditions, accident environments, and under theft scenarios. After completing these evaluations, the Russian military testing agency will make recommendations to the defense ministry regarding operational deployment of the technologies.

### Second line of defense

While we describe the work of securing nuclear weapons and materials capabilities as a "first line of defense," Sandia is also

moving ahead with a program described as the second line of defense (SLD), aimed at reducing the risks of nuclear smuggling. This program now extends to some 15+ countries in an effort to deter, detect, and interdict illicit transport of nuclear materials and weapons across borders.

Work in the SLD program to survey sites and install security and radiation detection systems is ongoing. SLD participants are also surveying and equipping foreign seaports to prescreen U.S.-bound container cargo.

### Facial recognition project

The automatic visual recognition of objects is a common problem across many security application activities. An intensive international effort is now being made to develop technology to recognize the faces of known terrorists from photographs. However, 2-D image recognition technologies suffer from variations in poses, expressions, disguises, and other variables.

Sandia's Richard Smith (left) and Anatoly Abakumov, part of a Russian delegation, examine a weapon shipping container as part of a conference of weapon security.



3-D recognition offers superior accuracy in this effort.

Sandia's Micro Optical Radar Facial Recognition Project is developing critical pieces of the technology needed to demonstrate the feasibility of facial recognition at a distance. An optical sensor under development depends on the development of a challenging multi-pixel, high-speed, low-noise, application-specific, integrated circuit that is both analog and digital in mode. If successful, the technology has wide application to many national security missions where remote recognition of 3-D features is of importance.

Potential uses include crime scene mapping for law enforcement, target detection and recognition for military applications, and collision avoidance systems for vehicles.

### Securing high consequence pathogens and toxins

More than 60 scientists from government-operated bioscience research labs around the world gathered in Albuquerque in early February 2004 to discuss how to keep dangerous pathogens and toxins out of the hands of terrorists. Hosted by Sandia's International Security Center, the goal of the first-of-its-kind program was to further cooperation among other governments to secure materials that could be used as biological weapons. Although most bioscience laboratories have systems to prevent workers from being accidentally exposed, no international guidelines exist to specify how labs should prevent theft or sabotage of these dangerous materials.

*"A flood of radioactive sources, from discarded cancer treatment machines advertised on the Internet to misplaced industrial gadgets that turn up in junkyards, have yet to be corralled by U.S. authorities three years after the Sept. 11 terrorist attacks, experts say — and could easily be exploited by terrorists seeking to make a dirty bomb. The material is so abundant and easy to obtain, the experts say, that it is almost inevitable that a U.S. city will be the target of a bomb salted with radioactive waste."*

—The San Francisco Chronicle,  
September 5, 2004

### Identifying and securing radiological sources

The recurring loss or theft of radioactive materials such as cobalt-60 and cesium-137, widely used in medicine and industry, has long been an issue for the world's public health and law enforcement officials. These materials can contain deadly amounts of penetrating radiation in a lipstick-sized package, and have caused deaths among children who have found them.

With the potential for their use in radioactive dispersal devices, or so-called "dirty bombs," they are even more of a threat. Such a weapon, made with conventional explosives and radioactive materials that would be scattered during a blast, may cause as much or more damage from fear and a panicked response as from the dangers of the explosives or the radioactive materials themselves. But they also have the potential to contaminate an entire city neighborhood to a level where demolition would be the only clean-up alternative.



Security for medical and industrial radioactive materials has become an increasingly important issue, post-9/11 as the potential for their use in radioactive dispersal devices, or so-called "dirty bombs" makes them more of a threat.

As part of Sandia's RTR efforts, a Sandia team has worked with other DOE laboratories and governments of numerous foreign countries to help locate, repackage, secure in place or move to secure locations large quantities of medical and commercial radioactive materials. Often these materials are stored in facilities that offer little protection. The goal of this work is to lock up radiation sources that could become ingredients of a terrorist dirty bomb, while insuring that they remain available for legitimate medical or commercial applications. We have completed work in Lithuania, Greece, Russia, and Tanzania. Work is under way in Latvia, Estonia, Poland, and Egypt.

Sandia is working to locate and control the sources of radiological materials, which may number up to two million in the U.S. alone. The Radioactive Source Registry Tracking System will first track all DOE-sealed radioactive sources and provide decision makers with some estimation of their potential risk. Currently, DOE is the primary user of the system, but DOE has also offered it to the DHS, the Federal Bureau of Investigation, and the EPA for use



as a tool to support tracking, assessment, and recovery of these sources.

Sandia also assisted DOE/NNSA in developing a strategic plan to secure and control foreign-origin radiological materials. Such material could potentially be acquired and used against U.S. interests. We are leading a project to search for and secure these materials worldwide.

### ***New approaches and technologies for detecting proliferation activities***

Sandia maintains technical capabilities to watch for terrorist or other activities that threaten national security. From concept stages, to demonstration, to operational systems, we develop the technologies needed to advance sensors and processing systems. Our technologies range from microscopic in situ instruments to large remote sensing systems that monitor the globe.

### **Integrated worldwide systems**

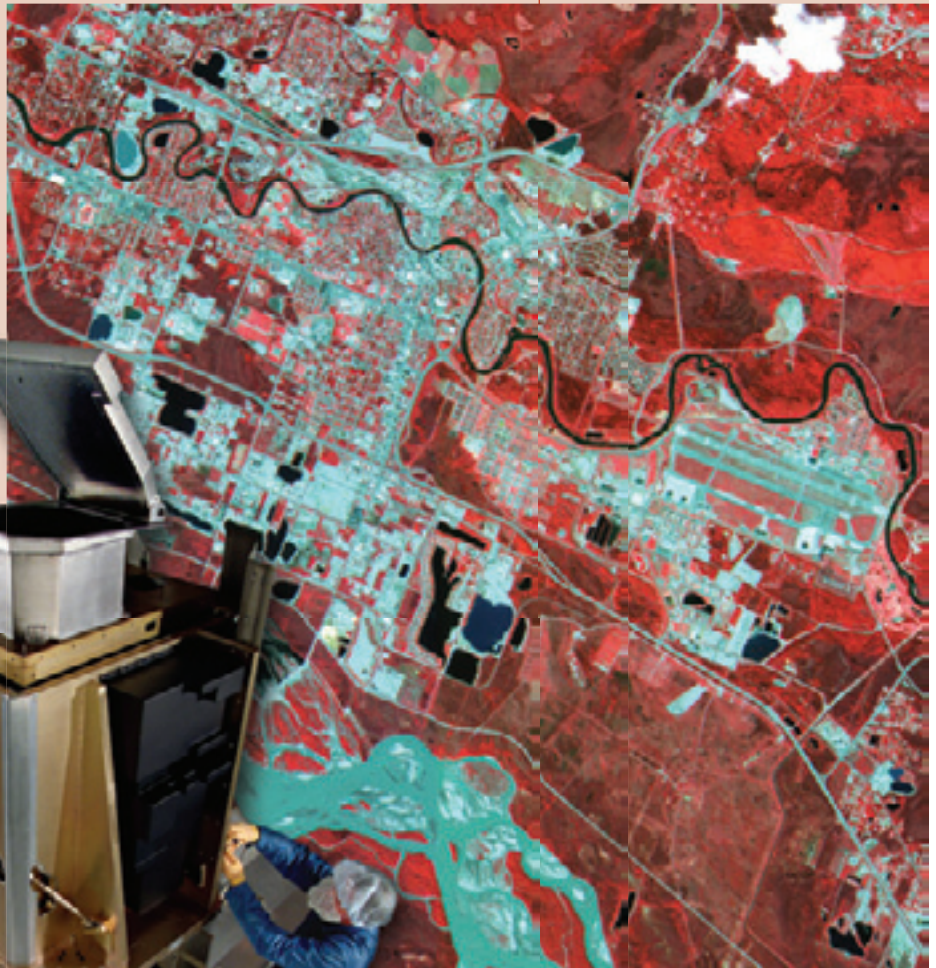
In late December 2003, the U.S. Air Force launched NAVSTAR Global Positioning System (GPS) Space Vehicle Number 47, with a Sandia-supplied Global Burst Detector (GBD) payload onboard. Early in 2004, the GBD payload was powered on and tested using Sandia and Los Alamos national laboratories facilities. The launch was the first of four scheduled NAVSTAR launches for Fiscal Year 2004. It was the tenth of 21 satellites of the Block IIR generation of NAVSTAR to be launched by the Air Force.

The GBD is a key component of the U.S. Nuclear Detonation Detection (NUDET)

System that provides a worldwide capability to detect, locate, and report nuclear detonations in the Earth's atmosphere or in near space. Today there are NUDET sensors on all of the 24 satellites in operation in the NAVSTAR GPS constellation. Every year Sandia supports new launches.

GBD payloads moved into a new generation during the year with the July 2004 delivery of a new GBD payload. Sandia is developing a significantly enhanced optical sensor for the new GBD payloads. This new sensor augments the current optical NUDET system and has 4,096 optical sensors in a 64 x 64 photodetector array. Signals from this array are sampled, digitized, and processed by 256 custom, application-specific, radiation-hardened, integrated circuits, designed and fabricated at Sandia. This NNSA-funded sensor was the result of a ten-year development effort making use of Sandia's research, engineering, and manufacturing capabilities to create a multilayer 3-D sensor package. A new generation of GBDs with the sensor will be launched beginning in fall 2006. Sandia has completed fabrication of the first three enhanced optical flight sensors for the new generation GBD payload. These enhanced optical sensors will be integrated into the GBD payloads beginning in 2005.

In another innovation, Sandia continues to make progress on the first of a new generation of integrated microsystems for satellite applications. Integrated microsystems in the new ENRAD sensor process data 10,000 times faster with sharply reduced power consumption. Size and



A new Sandia toolkit is designed to plug in to commercial remote sensing software to enhance the utility of multispectral satellite data.

weight are reduced by a factor of 2,000. The ENRAD sensor was launched into orbit in June 2004, and Sandia engineers are evaluating its operation and performance.

Sandia developed a number of new analysis techniques and tools for multispectral and thermal data based on more than 8,500 images from the Multispectral Thermal Imager satellite. The satellite, which exceeded its operational mission goal of three years and has completed more than 20,000 orbits, became a powerful space-based research and development project for nonproliferation research and engineering.

The Sandia Multispectral Analyst Remote Sensing Toolkit, or SMART, was developed as a result of the development of these new analysis techniques and released under government license to 22 organizations.

### **Iran's Nuclear Challenge**

*"Iran announced on [July 30] that it had resumed the construction of centrifuges that are capable of producing material for a nuclear bomb.... There would be little reason for Iran to take the provocative step of restarting centrifuge construction now unless it also intended to resume operations at some later date."*

—NY Times, August 4, 2004

### **Cooperative international security leadership**

The importance of international cooperation to enforce nonproliferation has become starkly clear. Our government has been long concerned about the risk of conflict, terrorism, and the proliferation

of weapons of mass destruction in the Middle East and other unstable areas of the globe. Sandia has expanded its efforts to support a range of cooperative international security programs, in turn supporting the U.S. nonproliferation policy globally.

The success of Sandia's Cooperative Monitoring Center (CMC) in Albuquerque, established in 1994 to support the DOE, DoD, and State Departments cooperative programs, led to CMC in Amman, Jordan, which marked its official grand opening in late 2003. CMC-Amman provides a forum for regional training on nonproliferation technologies, new monitoring capabilities, monitoring demonstrations, and interactions among scientists, engineers, and policymakers.

More recently, the Center facilitated an agreement among the NNSA, the Arab Science and Technology Foundation, and CMC-Amman. The agreement outlines a multi phase effort to help rebuild key elements of Iraq's scientific infrastructure. Early in 2004, foundation members traveled to Baghdad to recruit an Iraqi team and complete work on a survey of the nation's battered scientific infrastructure. Scientists in Iraq have been isolated from mainstream science for nearly 15 years. Survey results showed major areas of interest, including water resources, public health (including medical infrastructure), and environmental restoration. Agriculture, biotechnology, and communication system restoration were also rated high in the survey. Next steps involve increasing international funding for high-priority projects.



Maj. General Mohammad Shiyyab (center), Director of the Cooperative Monitoring Center -Amman leads a tour of the facility during opening ceremonies late in 2003.

## **Non-weapon enterprises provide jobs**

The Russian Transition Initiative's first commercial joint venture was established with Numotech, a U.S. medical devices firm, and Spektr-Conversion, a Russian entrepreneurial start-up company. The joint venture designs and manufactures several medical equipment devices and may eventually employ up to 500 people. Sandia has been a key technical player, improving Numotech's products. A recent development has seen an authorization by Overseas Private Investment Corporation for \$10 million in loans to move the venture forward once Russian approval is obtained.

A Department of State-sponsored nonproliferation program provides technical support of two international science centers in Moscow and the Ukraine. Through this

program, Sandia researchers work with scientists in the former Soviet bloc to fund research projects, ensuring that no dual use, i.e. weapons-related research, is funded.

A second program, the Russian Transition Initiative, sponsored by NNSA, dates back to the early 1990s. Goals of this initiative include reducing the size of three nuclear weapon enterprises in Russia and finding non-weapon employment with commercial potential for highly skilled former weapons scientists and engineers.